

Does Social Isolation Predict Hospitalization and Mortality Among HIV+ and Uninfected Older Veterans?

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OBJECTIVES: To compare levels of social isolation in aging veterans with and without the human immunodeficiency virus (HIV) and determine associations with hospital admission and mortality.

DESIGN: Longitudinal data analysis.

SETTING: The Veterans Aging Cohort Study (VACS), at eight VA Medical Centers nationally.

PARTICIPANTS: Veterans aged 55 and older enrolled in VACS from 2002 to 2008 (N = 1,836).

MEASUREMENTS: A Social Isolation Score (SIS) was created using baseline survey responses about relationship status; number of friends and family and frequency of visits; and involvement in volunteer work, religious or self-help groups, and other community activities. Scores were compared according to age and HIV status, and multivariable regression was used to assess effects of SIS on hospital admission and all-cause mortality.

RESULTS: Mean SIS was higher for HIV-positive (HIV+) individuals, with increasing difference according to age ($P = .01$ for trend). Social isolation was also more prevalent for HIV+ (59%) than uninfected participants (51%, $P < .001$). In multivariable regression analysis of HIV+ and uninfected groups combined, adjusted for demographic and clinical features, isolation was independently associated with greater risk of incident hospitalization (hazard rate (HR) = 1.25, 95% confidence interval (CI) = 1.09–1.42) and risk of all-cause mortality (HR=1.28, 95% CI = 1.06–1.54). Risk estimates calcu-

lated for HIV+ and uninfected groups separately were not significantly different.

CONCLUSION: Social isolation is associated with greater risk of hospitalization and death in HIV+ and uninfected older veterans. Despite similar effects in both groups, the population-level effect of social isolation may be greater in those who are HIV+ because of the higher prevalence of social isolation, particularly in the oldest individuals. *J Am Geriatr Soc* 61:1456–1463, 2013.

Key words: social isolation; aging; HIV/AIDS; hospitalization; mortality; outcomes of care

Social isolation is common in older adults and has important effects on health care and health outcomes.^{1,2} Numerous studies have demonstrated greater overall risk of mortality^{3–5} and geriatric morbidity such as falls⁶ and cognitive and functional decline,^{7,8} especially in individuals with chronic conditions such as coronary artery disease,^{9,10} cancer,¹¹ and diabetes mellitus.¹² There is less information about isolation of older adults with human immunodeficiency virus (HIV) despite recent advances in antiretroviral therapy that have transformed HIV to a chronic condition with longer life expectancy and “graying” of the infected population.^{13,14} The incidence of new HIV infections in older adults has also increased dramatically in the last decade.¹⁵ These trends suggest not only a need for more information about effects of isolation on mortality for the growing number of older adults living with chronic HIV infection, but also a need to understand possible effects on acute care usage, given longer life expectancies in this population.

Adults living with HIV may be at higher risk than the aging population with other chronic conditions for social isolation as they age. Many have lost friends or partners who were also infected but did not survive the early years of the epidemic.^{16,17} The stigma attached to HIV may also inhibit social networks and support. This stigma is especially strong for populations who are disproportionately

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infected, such as African Americans and Hispanics,^{18,19} as well as men who have sex with men.²⁰ Furthermore, HIV infection itself intensifies many normal aging processes and increases the incidence and severity of frailty.^{21–23} Thus, HIV-positive (HIV+) individuals may be at greater risk of isolation and frailty, leading to greater overall risk of hospitalization and death than an uninfected cohort. Comparisons of the prevalence and effects of social isolation between HIV+ and uninfected older adults are lacking. Specifically, current studies have yet to examine how components of social isolation, such as limited engagement with friends, family, or community, may differentially affect acute care usage and mortality of HIV+ and uninfected older adults.

The Veterans Aging Cohort Study (VACS) dataset provides a unique opportunity to study the prevalence and effects of social isolation on inpatient admission and outcomes of care in an aging population in a multisite, longitudinal cohort of veterans and to compare these effects on HIV+ individuals with those on uninfected individuals. The objectives were to compare levels of social isolation in aging veterans with and without HIV and to determine associations with incident hospital admission and all-cause mortality.

METHODS

Study Design and Sample

The Veterans Aging Cohort Study is an observational cohort of HIV+ and uninfected individuals designed to examine the effect of social, medical, and psychiatric factors on aging and clinical outcomes. Participants are enrolled prospectively from infectious disease and general medicine clinics at eight Veterans Affairs (VA) Medical Centers (VAMCs; Atlanta, GA; Baltimore, MD; Bronx, NY; New York, NY; Houston, TX; Los Angeles, CA; Pittsburgh, PA; Washington, DC). Uninfected individuals are matched to individuals in the infected group according to age, race, and site. A full description of VACS recruitment, enrollment rates, study instruments, study measures collected, and quality control is given elsewhere.²⁴ Briefly, VACS collects information on sociodemographic characteristics, comorbidities, and measures of health behaviors and beliefs from patient surveys and administrative and clinical data sources through the VA national electronic medical record. Institutional review boards at all sites approved the study, and all veterans provided written informed consent. For the present study, a sample of individuals from VACS 8 with full data available aged 55 and older when they completed the VACS baseline survey between June 1, 2002, and September 30, 2008, were analyzed (Table 1).

Measurements

Social Isolation

Social isolation has been defined as a state of lacking social engagement, belonging, and contact with others.²⁵ Given the lack of consensus in prior literature on how best to measure social isolation in different populations, a Social Isolation Score (SIS) was created that would be well suited to studying HIV+ and uninfected older adults by leveraging strengths of the VACS dataset designed to study

these populations. First, domains for this score were identified from the VACS 8 baseline survey that captured important concepts of isolation from a review of the existing literature: frequency of visits by close friends,^{1,2} frequency of visits by family,^{1,2} number of close friends and family combined,^{1,2,26} use of self-help groups in the past year,²⁰ volunteer work or involvement with a community organization,²⁷ attendance of religious events,²⁸ relationship status,²⁹ and living alone.³⁰ Next, for each domain, one question was chosen from the VACS 8 baseline survey that best represented the concept, and 1 point was assigned for each response indicating isolation and 0 points for each response indicating lack of isolation. For questions with multiple responses, 1 point was assigned for the most-isolated response, 0 points for the least-isolated response, and 0.5 points for any response in between. The final SIS contains eight variables, with a range of possible scores from 0 to 8 in 0.5-point increments (Table 2). Finally, the Spearman test was used to assess construct validity, and significant correlation was found between SIS components ($P < .05$ for 23 of 28 unique combinations).

Clinical Outcomes

The primary outcomes of interest were incident admission for acute inpatient care at any VAMC and all-cause mortality between study enrollment on June 1, 2002, and September 30, 2010, to allow at least 2 years of follow-up after the last enrollment date. To account for variations in length of follow up time, time-to-event analyses were used for both outcomes. Because data for the SIS were derived from the baseline survey, information on the first hospitalization to occur any time after enrollment in VACS 8 was abstracted. Dates of death were used to determine time to death within the study and to conduct survival analyses.

Potential Confounders

Covariates were age (continuous), race and ethnicity (white non-Hispanic vs non-white or Hispanic), and income (<\$25,000 vs ≥\$25,000/year) (Table 1). The five most-frequent comorbidities were identified from participant *International Classification of Diseases, Ninth Revision*, codes at the time of enrollment (hypertension, dyslipidemia, diabetes, hepatitis C, coronary artery disease), and a sum total of comorbidities was calculated for each participant. A sum total of hospitalizations in any VAMC during the study dates was also calculated for each participant. Alcohol abuse was assessed using the Alcohol Use Disorders Identification Test,^{31,32} and the Beck Depression Inventory was used to assess for depressive symptoms. Tobacco and other substance use were explored as covariates in the initial model but were excluded from the final model given nonsignificant associations with the outcomes of interest. Depression and alcohol abuse were also nonsignificant but were retained in the final model given previous studies suggesting relationships between isolation, depression^{3,25} or alcohol use,³³ and mortality.

Analyses

It was suspected that social isolation would be higher in HIV+ participants a priori based on previous evidence of

Table 1. Participant Characteristics (N = 1,836)

Characteristic	Overall	HIV+	Uninfected	P-Value
	n (%)			
Demographic				
Age				<.01
55–59	977 (53)	497 (59)	480 (49)	
60–64	316 (17)	150 (18)	166 (17)	
65–69	252 (14)	103 (12)	149 (15)	
70–74	134 (7)	47 (6)	87 (9)	
≥75	90 (5)	24 (3)	66 (7)	
Race and ethnicity				.01
Hispanic or non-white	1,244 (68)	599 (71)	645 (65)	
White, non-Hispanic	592 (32)	248 (29)	344 (35)	
Reported household income, \$ ^a				<.01
<25,000	1,304 (71)	654 (77)	650 (66)	
≥25,000	438 (24)	160 (19)	278 (19)	
Clinical				
Beck Depression Inventory				.05
Negative screen	1,401 (76)	628 (74)	773 (78)	
Positive screen	435 (24)	219 (26)	216 (22)	
Alcohol abuse				.33
Negative screen	1,374 (75)	643 (76)	731 (74)	
Positive screen	462 (25)	204 (24)	258 (26)	
Comorbidities ^b				<.01
Hypertension	999 (54)	330 (38)	669 (67)	
Dyslipidemia	572 (31)	179 (21)	393 (39)	
Diabetes mellitus	570 (25)	149 (17)	321 (32)	
Hepatitis C	327 (18)	231 (27)	96 (10)	
Coronary artery disease	237 (13)	73 (8)	164 (16)	
Number of comorbidities				<.01
0	523 (28)	317 (37)	206 (21)	
1	696 (37)	318 (37)	378 (38)	
2	485 (26)	183 (21)	302 (30)	
3–5	155 (8)	42 (5)	113 (11)	
Number of hospitalizations				<.01
0	1,031 (56)	422 (50)	609 (62)	
1	341 (19)	177 (21)	164 (17)	
2–4	327 (18)	177 (21)	150 (15)	
5–7	76 (4)	43 (5)	33 (3)	
>7	54 (3)	28 (3)	26 (3)	

^a Missing data for 94 (5%).

^b Most frequent comorbidities according to *International Classification of Diseases, Ninth Revision*, codes at time of Veterans Aging Cohort Study 8 enrollment.

Correction made after online publication August 8, 2013: the P-Value column in Table 1 has been updated.

lower levels of social support in this population. The descriptive analysis of baseline characteristics and incidence rates for outcomes were therefore stratified according to HIV status. SIS for each participant in the dataset, mean SIS score for all participants, and prevalence of social isolation was then calculated according to HIV status. To further explore differences in SIS prevalence and mean scores according to HIV status, unadjusted odds ratios for isolation (SIS ≥ 4) for HIV+ and uninfected participants were graphed according to age in 5-year brackets from 55 to 75 and 75 and older (Figure 1).

Relationships between SIS and time to outcomes were then examined using Cox multivariable regression models. Initially, Cox regressions were stratified according to HIV status, but it was noted that point estimates and effect sizes for the HIV+ and uninfected groups in these analyses were

similar. A single combined multivariable model was therefore created with all subjects using the same independent variables from the stratified analysis and an HIV interaction term. The interaction tests for HIV by SIS were nonsignificant in all combined analyses (for hospital admission, hazard rate (HR) = 0.82, 95% confidence interval (CI) = 0.63–1.06; for mortality, HR = 0.77, 95% CI = 0.55–1.09). It was therefore concluded that the effects of SIS on each group (HIV+ and uninfected) were not significantly different, and results of the combined Cox regressions are presented. Finally, the inflation of variance test was used to ensure that there was no collinearity between predictor variables. All regressions were performed with age, race, income, HIV status, number of comorbidities, depression, and alcohol abuse as covariates. All analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC).

Table 2. Components of Social Isolation Score (N = 1,836)

Total	All	HIV+	Uninfected	Social Isolation Score (P-value)
	n (%)			
Visits from close family				
<1/month	324 (17)	155 (18)	169 (17)	1
A few times a week to monthly	1,037 (56)	587 (58)	550 (66)	0.5
Daily	475 (26)	205 (24)	270 (27)	0
Mean score	0.46	0.47	0.45	(.16)
Visits from close friends				
Less than once a month	393 (21)	166 (20)	227 (23)	1
A few times a week to monthly	951 (52)	426 (50)	525 (53)	0.5
Daily	492 (27)	255 (30)	237 (24)	0
Mean score	0.47	0.45	0.49	(<.01)
Number of close family or friends				
0	183 (10)	100 (12)	83 (8)	1
1	200 (11)	104 (12)	96 (10)	0.5
>1	1,453 (79)	643 (76)	810 (82)	0
Mean score	0.15	0.18	0.13	(<.01)
Use of self-help or support group in last year				
No	1,430 (78)	640 (76)	790 (80)	1
Yes	406 (22)	207 (24)	199 (20)	0
Mean score	0.78	0.76	0.80	(.03)
Volunteer work or involvement with a community organization				
Little or none of the time	1,181 (64)	515 (61)	666 (67)	1
Some or a good bit of the time	387 (21)	197 (23)	190 (19)	0.5
Most or all of the time	268 (15)	135 (16)	133 (14)	0
Mean score	0.75	0.72	0.77	(<.01)
Frequency of attendance to religious events				
Never	477 (26)	231 (27)	246 (25)	1
<Twice yearly to 2–3 times a month	969 (53)	443 (52)	526 (53)	0.5
Every week to every day	390 (21)	173 (20)	217 (22)	0
Mean score	0.52	0.53	0.51	(.22)
Relationship status				
Single	1,257 (68)	683 (81)	574 (58)	1
Married or living with partner	579 (32)	164 (19)	415 (42)	0
Mean score	0.68	0.81	0.58	(<.01)
Living alone				
Yes	115 (6)	60 (7)	55 (6)	1
No	1,721 (94)	787 (93)	934 (94)	0
Mean score	0.06	0.07	0.06	(.18)
Mean Social Isolation Score	3.88	3.99	3.80	(<.001)

RESULTS

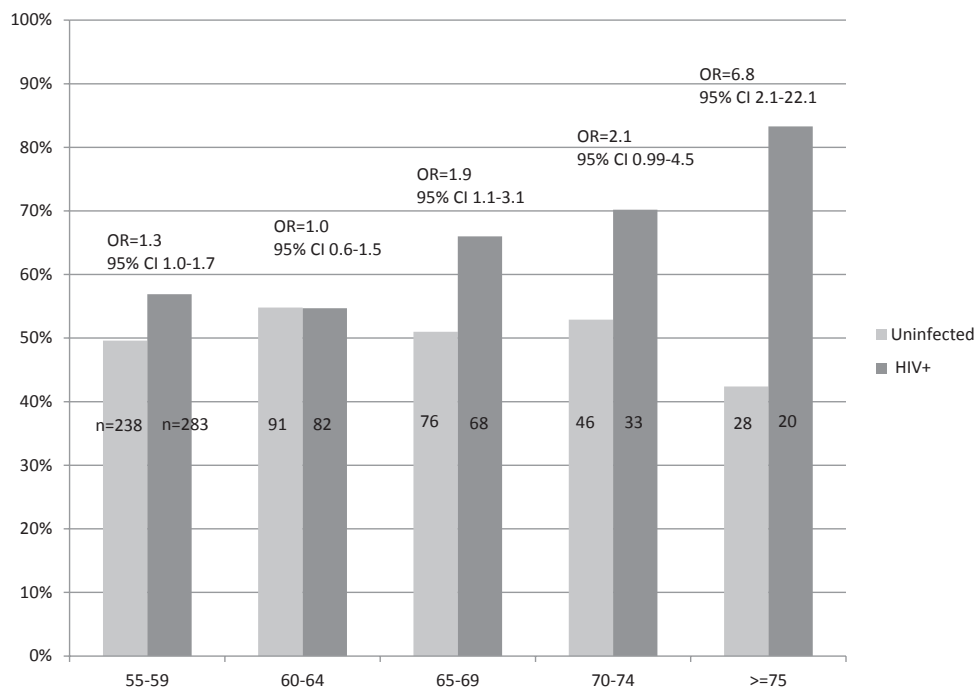
Complete data were available for 1,836 veterans aged 55 and older. Ages ranged from 55 to 91 (mean 61); 54% were uninfected, and 46% were HIV+; 99% were male; 68% were Hispanic or non-white; and 76% reported an annual income of less than \$25,000 (Table 1). Most participants (72%) had one or more comorbid condition, and most screened negative for depression (76%) and alcohol abuse (75%).

Social Isolation Scores for the entire sample ranged from 0 to 8 (mean 3.9 ± 1.2). Social Isolation Scores were also calculated for HIV+ and uninfected participants separately (Table 2). As shown in Table 2, mean scores for five of eight SIS components were higher for HIV+ participants, but only two of these (number of friends and family, relationship status) were significantly different. The overall mean SIS for HIV+ participants (4.0) was significantly higher than for uninfected participants (3.8; $P < .001$), and the odds of being isolated were significantly higher for HIV+ participants in all age brackets (except 60–64) with a trend

toward greater odds of isolation with older age (Figure 1). The overall prevalence of isolation ($SIS \geq 4$) was also greater for HIV+ participants (59%) than uninfected participants (51%; $P < .001$).

With respect to incident hospitalization, 805 veterans (43%) had at least one admission to a VAMC between 2002 and 2008 (Table 1). Overall, incidence of hospitalization was higher in HIV+ (113/1,000 person-years) than uninfected participants (70/1,000 person-years; $P < .001$), and mean time to admission was shorter in HIV+ than uninfected participants (1.8 vs 2.2 years; $P = .001$). After adjusting for age, race and ethnicity, income, number of comorbidities, depression, substance abuse, and HIV status, isolation was independently associated with greater risk of incident hospitalization (HR = 1.25, 95% CI = 1.09–1.42) in combined analyses of HIV+ and uninfected participants (Table 3).

Similar to incident hospitalization, incidence of mortality was higher for HIV+ participants (56/1,000 person-years) than for uninfected participants (33/1,000 person-years; $P < .001$), and time to death was shorter for HIV+ than



* Odds ratios are unadjusted and demonstrate the likelihood of isolation (SIS \geq 4) for HIV+ vs. uninfected patients in each age bracket

Figure 1. Percentage of veterans isolated (Social Isolation Score (SIS) \geq 4) according to age and human immunodeficiency virus (HIV) status. Odds ratios (OR) are unadjusted and demonstrate the likelihood of isolation (SIS \geq 4) for HIV-positive (HIV+) and uninfected individuals in each age bracket. CI = confidence interval.

uninfected participants (3.9 vs 4.8 years, $P < .001$). After adjusting for age, race and ethnicity, income, number of comorbidities, depression, substance abuse, and HIV status, isolation was independently associated with greater risk of all-cause mortality during the study period (HR = 1.28, 95% CI = 1.06–1.54) in combined analyses of HIV+ and uninfected participants (Table 3, Figure 2).

DISCUSSION

Although social isolation has similar effects on hospitalization and death for HIV+ and uninfected individuals, those with HIV are at substantially higher risk of being socially isolated. Although the effects of social isolation on mortality have been well documented in older adults,^{3–5} this is the first study to include a large number of older HIV+ individuals; it also presents novel findings on the effects of social isolation on acute care use (incident hospitalization) in this population and suggests a need to reframe current paradigms about hospitalization in HIV+ older adults. Existing studies of hospitalization in HIV+ individuals focus on acute presentations or specific complications of HIV infection,³⁴ but in the current era of potent antiretroviral therapies, HIV+ individuals are frequently admitted for (and die from) chronic conditions that characterize the aging population as a whole.³⁵ Rather than focusing on HIV-related comorbidities, our findings suggest a need to understand aging HIV+ individuals' risks for hospitalization and mortality in the broader context of their social lives and to increase preventative efforts for those with

Table 3. Effects of Social Isolation Score (SIS) on Inpatient Admission and All-Cause Mortality (N = 1,836)

Effects of SIS on:	HR (95% Confidence Interval)
Inpatient admission during study period	
SIS \geq 4	1.25 (1.09–1.42)
HIV+	1.67 (1.46–1.91)
Age (continuous, per year increase)	1.01 (1.00–1.02)
Number of Table 1 comorbidities (continuous, per unit increase)	1.33 (1.24–1.42)
Non-white race or ethnicity	1.44 (1.24–1.67)
Income <\$25,000/year	1.57 (1.34–1.86)
Depression screen positive	1.13 (0.97–1.32)
Alcohol abuse screen positive	0.98 (0.84–1.14)
Risk of death during study period	
SIS \geq 4	1.28 (1.06–1.54)
HIV+	2.02 (1.67–2.46)
Age (continuous, per year increase)	1.05 (1.04–1.07)
Number of Table 1 comorbidities (continuous, per unit increase)	1.13 (1.03–1.25)
Non-white race or ethnicity	1.25 (1.02–1.53)
Income <\$25,000/year	1.38 (1.08–1.77)
Depression screen positive	1.18 (0.95–1.46)
Alcohol abuse screen positive	1.17 (0.94–1.46)

Hazard ratios (HRs) are adjusted for all variables listed above.
HIV+ = human immunodeficiency virus positive.

low social support. Although it was found that social isolation affected these outcomes for HIV+ and uninfected individuals in the cohort, the finding that the prevalence of

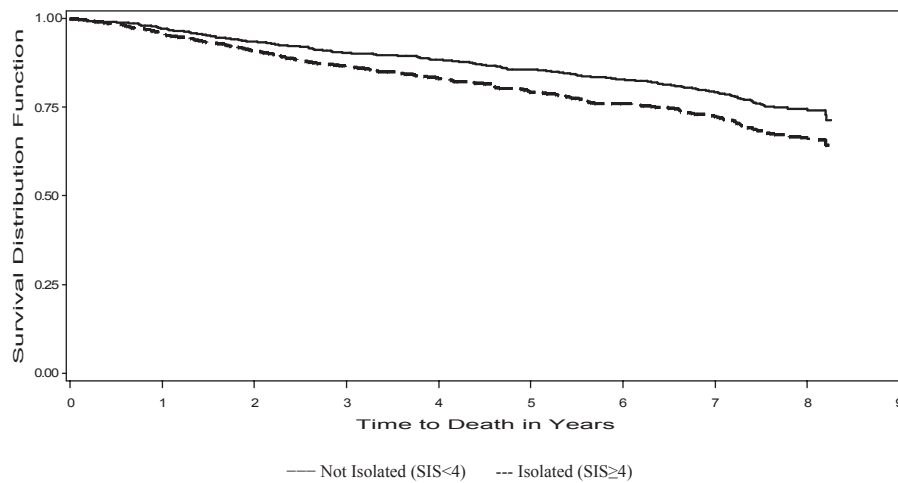


Figure 2. Survival analysis for socially isolated versus nonisolated veterans. SIS = Social Isolation Score.

social isolation is higher in HIV+ older adults, particularly at older ages, underscores the need to prioritize such efforts for this population.

Several factors may explain the finding that social isolation is more prevalent in HIV+ than uninfected older adults, with increasing difference with older age (Figure 1). First, older adults with HIV are significantly more economically and politically marginalized than uninfected counterparts at all ages, which may predispose them to social isolation.^{36,37} Second, it may be that greater stress levels associated with long-term HIV survival³⁸ and intensified geriatric syndromes in HIV+ participants such as cognitive impairment further inhibit their ability to establish and maintain social ties.³⁹ Third, low social support itself is a predictor for delay in HIV testing⁴⁰ and treatment⁴¹ thus placing older, more-isolated individuals at risk of worsening health and compounding isolation.⁴² Fourth, many older adults with HIV experience a heightened sense of loneliness, which may lead to anxiety, depression, and further withdrawal from social networks that can have protective effects on isolation.^{43,44} Moreover, the young age of half of the sample (53% <60) probably attenuates the overall difference in prevalence of isolation seen between HIV+ (59%) and uninfected (51%) participants in this study; this overall difference seems likely to increase as this population continues to age. Finally, given recent research showing important effects of loneliness on overall health,^{45,46} disability, and mortality,⁴⁷ these findings underscore the need to study overlapping effects of social isolation and loneliness for aging populations.

These findings also have several important health policy implications. First, the study focused on individuals in the VA system for whom access to care is not a concern; the health effects and associated costs of isolation may be even greater for individuals outside this system. Second, although the number of older, HIV+ individuals is rising, the number of providers in HIV medicine and geriatrics remains small.⁴⁸ Thus, efforts to address social isolation in older, HIV+ adults will also need to engage hospitalists, emergency medicine physicians, and others in acute care specialties, as well as leverage nonphysician resources such as case management and community-based organizations.⁴⁹ Third, there is growing evidence that

interventions to address social isolation through activities such as support groups, social activities, home visits, and Internet engagement can reduce isolation in older adults.⁵⁰ Although these interventions will have associated costs in terms of time, effort, and funding, they may be less expensive than high rates of acute care utilization and may result in better outcomes as well. Fourth, it is likely that socioeconomic status plays an important role in mediating social isolation as well as the outcomes of hospitalization and mortality reported. Although further study is needed to explore this relationship, as well as possible effects on overall quality of life, it is recommended that clinicians prioritize screening for social isolation of the most-vulnerable individuals first; the oldest and poorest, with the worst quality of life, may be most likely to be clinically affected by social isolation. Finally, as HIV+ individuals age, high levels of social isolation may place additional strain on an overburdened system of nursing homes and skilled nursing facilities.^{51,52} Previous studies have shown that living alone,^{53,54} fewer family contacts,^{53,55} and fewer non-kin social supports⁵² are all correlated with nursing home placement, although a more-comprehensive assessment of isolation factors such as those contained in the SIS has not been studied. This is an important area for future aging research, with a specific focus needed on HIV+ individuals, given their risk of isolation as they age.

This study has several limitations. First, it is a longitudinal study using observational data, so inferences cannot be made about causality between social isolation and inpatient admission or mortality. Second, data were used from baseline surveys to create the SIS, and thus, components of this measure were considered to have “fixed effects” on overall social isolation. Third, severity of illness was not adjusted for in the final analysis because when scores from a validated HIV morbidity and mortality prediction tool (the VACS Risk Index)⁵⁶ were included in the models, it was found that differences in the outcomes of interest were no longer significant. Given that social isolation may well mediate poor disease control and overall severity of illness,⁵⁷ it was felt that inclusion of these risk index scores in the models would be overadjustment. The causal pathways between social isolation and outcomes remain unknown and represent an important area for future

research. Fourth, although items for the SIS were carefully selected based on current literature on this topic and tested for construct validity, more formal psychometric testing for internal and external validity were not performed. The scale also differs from one of the most rigorously validated instruments to assess social isolation (the Lubben Social Network Scale, which focuses on closeness and redundancy of social contacts in family and friends) in that the SIS incorporates forms of social engagement beyond family and friends such as community volunteering, self-help groups, and religious activity that are not captured in the Lubben Social Network Scale.⁵⁸ Finally, the sample of veterans is predominantly male and non-white, so the results may not be generalizable to women and whites.

In conclusion, social isolation is associated with greater risk of hospitalization and death in HIV+ and uninfected older veterans. Despite similar effects in both groups, the population level effect of social isolation may be even greater in those who are HIV+ because of the higher prevalence of social isolation, particularly in the oldest individuals. Because the “graying” of the HIV+ population is projected to accelerate in the coming decades, a broader understanding of social isolation and the application of geriatric principles of inpatient care for this population is needed.

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Correction made after online publication August 8, 2013: the references have been updated.